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U.S. DEPARTMENT OF COMMERCE (REV 11-98)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

**TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371**

8348-56

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

Not Yet Assigned

099787499

INTERNATIONAL APPLICATION NO.  
PCT/GB99/03072INTERNATIONAL FILING DATE  
September 15, 1999PRIORITY DATE CLAIMED  
September 16, 1998

## TITLE OF INVENTION

A Process For Recycling Powder Coating Fines

APPLICANT(S) FOR DO/EO/US

Ian Kilner

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
  - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☒ has been transmitted by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
  - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☐ have been transmitted by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☐ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

## Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ Certificate of Mailing by Express Mail
20. ☒ Other items or information:

Express Mail Label No. EL 782181456

Applicant claims entitlement to small entity status

Acknowledgment Postcard

U.S. APPLICATION NO. (IF KNOWN) SEE 37 CFR

INTERNATIONAL APPLICATION NO.

ATTORNEY'S DOCKET NUMBER

Not Assigned

PCT/GB99/03072

8348-56

21. The following fees are submitted.

**BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :**

- ☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO ..... \$970.00
- ☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO ..... \$840.00
- ☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... \$690.00
- ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) ..... \$670.00
- ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) ..... \$96.00

**ENTER APPROPRIATE BASIC FEE AMOUNT =**

\$860.00

Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492 (e)). ☐ 20 ☐ 30

\$0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	20 - 20 =	0	x \$18.00	\$0.00
Independent claims	1 - 3 =	0	x \$80.00	\$0.00

Multiple Dependent Claims (check if applicable). ☐

\$0.00

**TOTAL OF ABOVE CALCULATIONS =**

\$860.00

Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) (check if applicable). ☒

\$430.00

**SUBTOTAL =**

\$430.00

Processing fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR 1.492 (f)). ☐ 20 ☐ 30 +

\$0.00

**TOTAL NATIONAL FEE =**

\$430.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable). ☐

\$0.00

**TOTAL FEES ENCLOSED =**

\$430.00

Amount to be refunded \$  
charged \$

☐ A check in the amount of \_\_\_\_\_ to cover the above fees is enclosed.

☒ Please charge my Deposit Account No. **19-1135** in the amount of **\$430.00**  
A duplicate copy of this sheet is enclosed.



☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **19-1135** A duplicate copy of this sheet is enclosed.

PATENT TRADEMARK OFFICE

**NOTE:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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SEIDEL, GONDA, LAVORNA & MONACO, P.C.  
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SIGNATURE

Gregory J. Lavorgna

NAME

30,469

REGISTRATION NUMBER

16 March 2001  
DATE

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
ACTING AS THE DESIGNATED/ELECTED OFFICE

In re: Patent application of	:	International Application No.:
Ian Kilner	:	PCT/GB99/03072
	:	
U.S. Serial No.: Not Yet Assigned	:	International Filing Date:
	:	15 September 1999
Filed: Concurrently Herewith	:	
	:	Atty. Docket No: 8348-56
For: A Process for Recycling Powder	:	
Coating Fines	:	Group Art Unit: Not Yet Assigned
	:	
	:	Examiner: Not Yet Assigned

**PRELIMINARY AMENDMENT OF NATIONAL STAGE APPLICATION  
BASED ON INTERNATIONAL APPLICATION (AS PUBLISHED)**

Commissioner for Patents  
Box PCT  
Washington, D.C. 20231

Dear Sir:

Prior to examination of the application and before calculation of the filing fee, please amend the application as follows on the basis of PCT/GB99/03072 as published by the International Bureau. Disregard subsequent amendments which were made before the IPEA/EP.

CERTIFICATE OF MAILING  
UNDER 37 C.F.R. 1.10

EXPRESS MAIL Mailing Label Number: EL 782181456 US  
Date of Deposit: MARCH 16, 2001

I hereby certify that this correspondence, along with any paper referred to as being attached or enclosed, and/or fee, is being deposited with the United States Postal Service, "EXPRESS MAIL - POST OFFICE TO ADDRESSEE" service under 37 C.F.R. 1.10, on the date indicated above, and addressed to: Commissioner for Patents, Box PCT, Washington, D.C. 20231.

Theresa McKinley  
Signature of person mailing paper

TERESA McKINLEY  
Type or print name of person

Charge any fee or credit any overage associated with this preliminary amendment or the application filing to Deposit Account No. 19-1135.

In the specification (of International Application PCT/GB99/03072 as published):

On page 4, after the last full paragraph, add the following new paragraph:

--EP-0683199A discloses a process in which a layer of fines is formed on a conveyor belt and subjected to heat up to coalescence of the powder by below decomposition or cross-linking.--

Replace the paragraph spanning pages 4-5 with the following paragraph:

--According to the present invention there is provided a process for recycling fines produced during the production of powder coatings comprising the steps of:  
depositing the fines onto conveyor means as a series of continuous lines;  
heating the lines of fines without fully melting or cross-linking them until they become sufficiently tacky to form agglomerated masses;  
cooling such agglomerated masses; and  
collecting the agglomerated mass.--

On page 5, after the first partial paragraph add the following new paragraph:

--The invention further provides a process plant for recycling fines in accordance with a process for recycling fines the process plant including:  
means for transporting the fines to be recycled as a series of continuous lines into a heating area and then into a cooling area.--

On page 5, after the first full paragraph, add the following new paragraph:

--The process of the invention preferably comprises the step of passing the fines under a profiled comb or plate to form the continuous lines. The lines preferably have triangular profiles and preferably have a depth of 0.5 to 1.0 cm.--

On page 5, delete the second full paragraph.

On page 5, replace the fourth full paragraph with the following paragraph:

--Further preferably the resulting particles have a size of 3 mm to 212 microns.--

On page 5, replace the sixth full paragraph with the following paragraph:

-- One example of a recycling process will now be described with reference to a production trial that was carried out by us, and which is described herein below.--

On page 6, delete the third full paragraph.

On page 9, replace the fourth paragraph with the following paragraph:

-- As illustrated in Figure 3, in a processing plant suitable for carrying out the recycling process of the present invention, the continuously moving belt is replaced by a screw feed unit 14a, that is, the fines feed hopper 11 feeds the fines 15 to be recycled into a screw feed unit 14a that is driven by motor 14c.--

Replace the paragraph spanning pages 10-11 with the following paragraph:

-- Although the recycling process of the present invention has been described by way of example to the fines being processed in a batch tray oven, or a moving conveyor belt and in a screw feed chamber, it is to be understood that the process could also be carried out in any other heating or curing apparatus which could achieve the partial cure profile as described herein.--

**In the claims:** (of International Application PCT/GB99/03072 as published):

Cancel claims 1-16.

Add the following new claims:

17. A process for recycling fines produced during the production of powder coatings comprising the steps of:

depositing the fines onto conveyor means as a series of continuous lines;  
heating the lines of fines without fully melting or cross-linking them until they  
become sufficiently tacky to form agglomerated masses;  
cooling such agglomerated masses; and  
collecting the agglomerated masses.

18. A process as claimed in claim 17, comprising passing the fines under a  
profiled comb or plate to form the continuous lines.

19. A process as claimed in claim 17, wherein the continuous lines of fines have  
triangular profiles.

20. A process as claimed in claim 17, wherein the lines of fines have a depth of  
0.5 to 1.0 cm.

21. A process as claimed in claim 17, wherein heating is by means of at least  
one infra red lamp.

22. A process as claimed in claim 17, wherein the conveyor means is a moving  
belt running at a speed to give the fines an exposure time of 1 to 5 seconds.

23. A process as claimed in claim 17, further comprising the step of processing  
the lines of agglomerated mass to produce particles of a desired particle size.

24. A process as claimed in claim 17, wherein the fines are heated at a  
temperature of 60 to 80°C.

25. A process as claimed in claim 24, wherein the fines are heated at a  
temperature of 70°C.

26. A process as claimed in claim 17, wherein after cooling, the cooled lines of agglomerated mass are crushed to produce particles of a desired particle size.

27. A process as claimed in claim 26, wherein the cooled lines of agglomerated mass are crushed to produce particles having a size of 3.00mm to 212 microns.

28. A process as claimed in claim 27, wherein any crushed particles having a size of less than 212 microns are removed.

29. A process plant for recycling fines in accordance with a process for recycling fines as claimed in claim 1, the process plant including:

means for transporting the fines to be recycled as a series of continuous lines into a heating area and then into a cooling area.

30. A process plant as claimed in claim 29 including a profiled comb or plate for forming the fines in continuous lines.

31. The process plant of claim 29, wherein the means for transporting the fines into a heating area and cooling area work continuously.

32. The process plant of claim 29, wherein the means for transporting the fines into a heating area and then into a cooling area is a moving belt.

33. The process plant of claim 29, wherein the heating area has heating means including at least one infra red lamp.

34. The process plant of claim 29, wherein the heating area has heating means including at least one ultra violet lamp.

35. The process plant of claim 29, wherein the cooling area includes means for producing a cool stream of air.

36. The process plant of claim 32 further comprising scraper means for cleaning the moving belt.

#### REMARKS

This preliminary amendment is made on the basis of International Application GB99/03072 as published by the International Bureau and disregards subsequent amendments before the IPEA/EP. This preliminary amendment, however, places the national stage application in substantially the same form as that in which the International Application was in when the IPEA/EP issued a favorable International Preliminary Examination Report. Multiple dependency has been removed from the claims.

Respectfully submitted,

IAN KILNER

BY: 

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

*In the Specification:*

Paragraph spanning pages 4-5 has been amended as follows:

According to the present invention there is provided a process for recycling fines produced during the production of powder coatings comprising the steps of:

depositing the fines onto conveyor means as a series of continuous lines;

heating the lines of fines without fully melting or cross-linking them until they become sufficiently tacky to form [an] agglomerated [mass] masses;

cooling such agglomerated [mass] masses; and

[processing] collecting the agglomerated [mass] masses [to produce particles of a desired particle size].

Fourth full paragraph on page 5 has been amended as follows:

Further preferably [, after crushing,] the resulting particles have a size of 3 mm to 212 microns.

Sixth full paragraph on page 5 has been amended as follows:

One [, non-limiting,] example of a recycling process [in accordance with the present invention] will now be described with reference to a production trial that was carried out by us, and which is described herein below.

Fourth paragraph of page 9 has been amended as follows:

As illustrated in Figure 3, in a [second embodiment of a] processing plant suitable for carrying out the recycling process of the present invention, the continuously

moving belt is replaced by a screw feed unit 14a, that is, the fines feed hopper 11 feeds the fines 15 to be recycled into a screw feed unit 14a that is driven by motor 14c.

Paragraph spanning pages 10-11 has been amended as follows:

Although the recycling process of the present invention has been described by way of example to the fines being processed in a batch tray oven, or a moving conveyor belt and in a screw feed chamber, it is to be understood that the process could also be carried out in any other heating or curing apparatus which could achieve the partial cure profile as described [in this patent] herein.

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A PROCESS FOR RECYCLING POWDER COATING FINES

The present invention relates to a recycling process. In particular, the present invention relates to a recycling process that reclaims the fines produced during the manufacture of powder coatings, such that the fines can be reused in powder coatings. Additionally, the present invention provides a processing plant for carrying out such recycling process.

As an alternative to using traditional liquid paints, powder coatings are sprayed onto everyday items, for example, fridges, ovens, filing cabinets etc.

Powder coatings adhere to the metal substrate of the item that is sprayed, by electrostatic attraction. The painted or coated item is then heated in an oven, or cured by, for example, infra-red radiation. This produces the appropriate chemical reaction that provides the metal substrate with its finished surface.

Additionally, and by the use of NIR technology (Near Infra-Red), substrates such as wood or plastic can also be painted or coated using powder coating technology.

Regardless of the method of curing or heating utilised, in order to ensure an optimal adhesion of the powder coating to the substrate of the item being coated, a homogeneous temperature through the whole powder, substrate and boundary layer is required.

Generally, such powder coatings are manufactured by mixing the raw materials together, for example, resins, curing agents, fillers, pigments etc, and then extruding same into a continuous sheet by the application of heat and pressure. On cooling the resultant sheet, same is broken up into rough

chips, which are then milled to produce a powder coating with a very specific particle size. The milling process is air fed to convey the product, as well as to take away the particles that are too small to meet the particular size specification. These small particles, which are commonly referred to in the industry as "fines", and are referred to throughout this application as "fines", are then collected on filters prior to being discharged into containers.

Although it is known to melt the fines into blocks and use the resulting blocks as an insulating material in building construction, as well as to use the fines as a filler or extender in battery casings, presently, the bulk of these collected fines are disposed of via landfill, which is not only costly, but is a waste of valuable raw materials and is environmentally unsound.

The reasons why such fines are mostly disposed of are that there are many problems associated with handling such fines. In particular:

- 1) Due to the extremely low bulk density of the fines, they occupy a large volume for storage, that is, given their very little mass;
- 2) Due to the physical nature of such fines, they are very difficult to handle and behave more like a liquid than a powder. Consequently, and due to their physical nature, they are not compatible with traditional powder handling techniques, or equipment for batch metering, blending or extrusion; and
- 3) Powder coating fines are by definition a "dust" and as a result thereof, they can easily be collected and contained as parts of a milling extraction plant. However, any attempt to re-utilise the collected fines as a raw material utilising standard equipment and technology, will energise the particles in such way as to have them extracted once again into the process dust collection system, or flow out, of any containing hoppers, thus defying any standard network operations.

Therefore, there is a need to provide a recycling process that converts the fines from a dust to a grain that is easier to handle. In particular, there is the need to provide a recycling process which can move the powder coatings industry towards a zero waste option.

In an attempt to devise such a process, we attempted a number of processes.

One of such processes involved processing the fines through a high pressure roll compactor. The roll pressure was varied from 5 to 100 bar and the screw feed was varied from minimum to maximum. It was observed that no compaction of the fines occurred and as a result thereof, it was concluded that such a method was not viable.

In a further attempt to provide a suitable process, the fines were placed in a high shear mixing vessel and heated via a steam jacket. The mixing blades and side refiner speeds were varied, together with the temperature. This resulted in the fines fusing into a solid block that almost destroyed the mixing vessel drive mechanism. In an attempt to overcome the observed problem, namely, the fines fusing into a solid block, several other attempts were made to cool down the mass, once the initial fusion temperature had been reached; however, all attempts in this regard failed, and no useful granulated material was produced. Once again, it was concluded that such a process was not viable.

With a view to trying to establish a more accurate profile of the fusion process, several experiments were undertaken in a laboratory oven. These involved placing 300g of fines onto a tray and then subjecting the fines to different temperatures, for different durations of time. Such an approach was adopted with a view to narrowing down the range at which the fines would start to fuse. On doing so, it was observed that if the temperature and

duration parameters were too low, no meaningful product could be produced, and if too high, the fines fused into solid block and hence, were unusable.

With reference to Table 1 below, the results of such experiments can be seen:

Duration	Temperature	% Product <sup>1</sup>
1 hour	70°C	58%
2 hours	70°C	83%

<sup>1</sup> The % Product column indicates final yield of granular material once the semi-fused mass was crushed and screened through a 3.0 mm screen and then sieved on a 212 micron screen to remove any fines.

It was observed that the resulting grains were easy to handle and could be readily used as either a finished, non-colour specific, powder coating, that is, once the grains had been crushed to the correct particle size, or as a raw material for use in producing a new, colour specific, powder coating. With reference to the latter use, the resulting grains are preferably added at an addition level of around 5% to the new, colour specific, powder coating.

In light of our findings it is believed that in order to make the fines reusable and more manageable, it is essential to heat the fines to a point where they become tacky or semi-fused i.e. up to a point where the fines are not fully melted or cross-linked. If over-heated, the coating is fully cured and cannot be reused as a powder coating.

According to the present invention there is provided a process for recycling fines produced during the production of powder coatings comprising the steps of:

heating the fines without fully melting or cross-linking them until they become sufficiently tacky to form an agglomerated mass;

cooling such agglomerated mass; and processing the agglomerated mass to produce particles of a desired particle size.

It is an object of the present invention to provide a recycling process that enables the fines produced during the production of powder coatings to be reused as a powder coating.

In a preferred embodiment, the fines are heated for a duration of 30 minutes to 4 hours, preferably 2 hours.

Further preferably, the fines are heated at a temperature of 60-80°C, preferably 70°C.

Further preferably, after crushing, the resulting particles have a size of 3mm to 212 microns.

Further preferably, any particles having a size of less than 212 microns are removed from the resultant product.

One, non-limiting, example of a recycling process in accordance with the present invention will now be described with reference to a production trial that was carried out by us, and which is described herein below:

#### Production trial:

Several tons of fines were processed in a steam heated tray oven. The trays were lined with Melinex (RTM), which is a high melting point plastic film that will prevent adhesion or coating of the trays.

After a period of two hours, at a temperature of 70° C, it was observed that the mass on the trays had transformed into a crude honeycomb of

product. This product was removed from the oven and allowed to cool on the trays.

The cooled mass was then removed from the trays and placed in a feed hopper to a crushing and screening plant. The particle size of the resulting grains produced was in the range of 3.00 mm to 212 microns.

The resulting grains were then reprocessed as a new raw material component in some test formulations at an inclusion rate of around 5%. The resulting test powder coatings were sprayed and baked in the normal QC process and found to be satisfactory.

In a further aspect of the present invention there is provided a process plant as specified in claim 9.

Non-limiting embodiments of a processing plant in accordance with the present invention will now be described by way of example and with reference to the accompanying drawings, in which:

Figure 1 is a schematic illustration of a first embodiment of a process plant in accordance with the present invention;

Figure 2 is a side elevation of the belt of the plant of Figure 1; and

Figure 3 is a schematic illustration of a second embodiment of a process plant in accordance with the present invention.

A first embodiment of a processing plant 10 in accordance with the present invention may include:

#### A) Fines Feed Hopper 11

The fines to be recycled were fed into a fines feed hopper 11. Preferably, the fines feed hopper 11 is designed so as to ensure that the fines



do not block the hopper 11 thereby giving a variable or a zero feed rate. In this connection, in order to avoid the fines from bridging, rat-holing or generally not flowing evenly through the fines feed hopper 11, the fines feed hopper 11 is provided with a pneumatic vibrator 12 and bottom agitator 12a. It is to be understood that other standard free flow hoppers designed to ensure even flow of the fines therethrough would also be suitable.

#### B) Continuous ribbed moving belt 14

The bottom portion of the fines feed hopper 11 feeds directly on to a continuously moving belt 14. At the exit point of the fines feed hopper 11, a profiled plate or comb 13 is provided, which has the effect of feeding or depositing the fines 15 onto the belt 14 as a series of continuous lines, that is, as opposed to a flat bed of powder (see Figure 2).

It is to be understood that by interchanging the comb 13, the profile of the lines of fines 15 deposited onto the belt 14 may be varied in shape and depth. A typical profile of a line of fines 15 deposited onto the belt 14 may be triangular in shape having a depth of 0.5cm - 1cm.

The belt 14 is preferably constructed from a heat resistant polymer, for example, a silicone rubber and additionally, is preferably smooth enough so that same can be easily cleaned. Furthermore, the surface of the belt 14 is preferably non-stick, such that the processed product is readily removable therefrom.

#### C) Curing Tunnel

The belt 14 transports the fines 15 into and through a curing tunnel at a rate that is preferably optimised to give the minimum amount of partial cross linking required to achieve the granule hardness and final spray characteristics that are required.

Preferably, the curing tunnel is heated by infra-red lamps 16, which heat the fines 15 being carried by the belt 14 from above. It is to be understood that in certain applications ultra violet radiation can be used as a suitable heat source .

The amount of heat or curing energy transferred to the fines 15, which are being transported by the belt 14, is dependent on the speed at which the belt 14 passes through the curing tunnel, as well as on the distance of the heat source, for example, the infra-red lamps 16, above the belt 14.

The skilled person will realise that once a partial cure profile is established for a particular grade of fines, the processing plant control settings can simply be set to those parameters for the treatment of the next batch of fines of that particular grade.

For a single lamp of around 1KW, set at about 5cm above the belt 14, the belt speed would run at such a rate to give the fines 15 an exposure time of around 1-5 seconds.

#### D) Cooling Section

Once the fines 15 have been appropriately part cured to the required parameters, the agglomerated lines of fines are transported by the belt 14 through a cooling stage. Given the small, low line profile of the lines of agglomerated fines, which will cool quite rapidly, cooling of the lines of agglomerated lines can be achieved by running the belt 14 through a cooling chamber 17, or simply, by exposing the agglomerated lines of fines to the open air.

The cooled agglomerated lines of product fall off the end of the belt 14 into a container, or directly into the extruder feed hopper 18.

Unlike the batch oven produced material, which produces a large honeycomb of partially cured product, which needs to go through a crushing and screening process, the agglomerated material produced by this continuous process is directly reusable at the extruder stage of powder paint production.

A final scraper blade 19 cleans the belt 14 and the scrapings fall into the receiving container or extruder feed hopper 18.

As illustrated in Figure 3, in a second embodiment of a processing plant suitable for carrying out the recycling process of the present invention, the continuously moving belt is replaced by a screw feed unit 14a, that is, the fines feed hopper 11 feeds the fines 15 to be recycled into a screw feed unit 14a that is driven by motor 14c.

The design of the hopper, hopper/screw feed interface and screw profile of the screw fed unit 14a are specifically designed to ensure a constant and controlled flow of fines through the system. Moreover, the materials of construction of the screw feed unit 14a ensure that part cured fines do not coat the plant interior, which facilitates cleaning of the plant.

The principle of a plant including a screw feed unit 14a is similar to the belt plant described above, in that the heating and curing energy is provided by infra-red lamps; although, it is to be understood that in certain applications ultra violet lamps may be used instead. Additionally, and although the screw feed unit replaces the belt conveying system, the heating and cooling stages work to the same principles.

The possible advantages of a plant incorporating a screw feed unit 14a may be that the fines being recycled are continually mixed or turned over by the action of the screw feed auger, which enables the radiation provided by the heat source to be more efficiently distributed throughout the total mass of fines being recycled.

Both the above plants have been designed to run continuously, as opposed to a batch oven process. They have also been designed to give a heat energy exposure time to achieve the minimal cross link format of a few seconds, as opposed to several hours in a conventional oven. With both of the continuous process plants described above, the physical characteristic of the recycled fines differs from the granules produced in the batch oven process.

As the additional granulating and screening processes have been eliminated, the recycled product has a more varied particle size distribution. Also, as the processes are tuned to achieve the minimum input of partial cure energy, the final recycled product is softer than an oven produced material.

However, on a production scale where the continuous process has been utilised, re-work inclusion rate of 50-100% have been achieved compared with 5% on the batch oven process. As a result thereof, if the plants are retro-fitted to existing extrusion lines, a closed loop can be achieved from the fines cyclone or discharge point on the mill directly to the extruder feed hopper, thus, achieving very close to 100% recovery of all fines generated.

Although the recycling process of the present invention has been described by way of example to the fines being processed in a batch tray oven, or a moving conveyor belt and in a screw feed chamber, it is to be understood that the process could also be carried out in any other heating or

curing apparatus which could achieve the partial cure profile as described in this patent.

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## CLAIMS

1. A process for recycling fines produced during the production of powder coatings comprising the steps of:  
heating the fines without fully melting or cross-linking them until they become sufficiently tacky to form an agglomerated mass;  
cooling such agglomerated mass; and processing the agglomerated mass to produce particles of a desired particle size.
2. A process as claimed in claim 1, wherein the fines are heated for 30 minutes to 4 hours.
3. A process as claimed in claim 2, wherein the fines are heated for 2 hours.
4. A process as claimed in any one of the preceding claims, wherein the fines are heated at a temperature of 60-80° C.
5. A process as claimed in claim 4, wherein the fines are heated at a temperature of 70° C.
6. A process as claimed in any one of the preceding claims, wherein after cooling, the cooled agglomerated mass is crushed to produce particles of a desired particle size.
7. A process as claimed in claim 6, wherein the cooled agglomerated mass is crushed to produce particles having a size of 3.00mm-212 microns.

8. A process as claimed in claim 7, wherein any crushed particles having a size of less than 212 microns are removed.
9. A process plant for recycling fines in accordance with a process for recycling fines as claimed in any one of the preceding claims, the process plant including:  
means for transporting the fines to be recycled into a heating area and then into a cooling area.
10. The process plant of claim 9, wherein the means for transporting the fines into a heating area and then into a cooling area is a moving belt.
11. The process plant of claim 9, wherein the means for transporting the fines into a heating area and then into a cooling area include a screw feed unit.
12. The process plant of any one of claims 9 to 11, wherein the means for transporting the fines into the heating area and cooling area work continuously.
13. The process plant of any one of claims 9 to 12, wherein the heating area includes heating means which, in use, heat the fines without fully melting or cross-linking them until they become sufficiently tacky to form an agglomerated mass.
14. The process plant of claim 13, wherein the heating means include at least one infra red lamp.
15. The process plant of claim 13, wherein the heating means include at least one ultra violet lamp.
16. The process plant of any one of claims 9 to 15, wherein the cooling area includes means for producing a cool stream of air.

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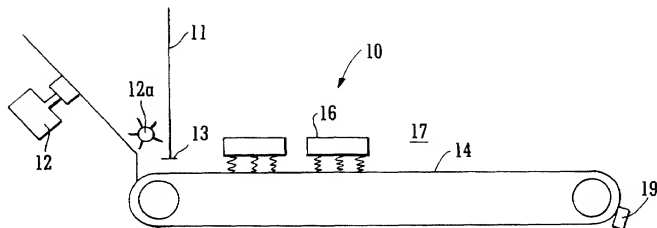


FIG. 1

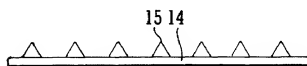
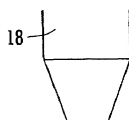


FIG. 2

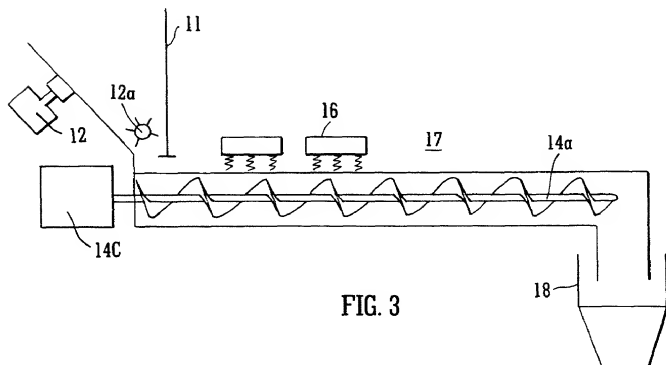


FIG. 3



## DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are stated below next to my name.

I believe I am an original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled:

### **A PROCESS FOR RECYCLING POWDER COATING FINES**

the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code §119(a)-(d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

9820089.2	GB	16 September 1998	Priority Claimed
(Number)	(Country)	(Day/month/year filed)	Yes [X] No [ ]

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below.

\_\_\_\_\_  
(Application Number)  
(Filing Date)

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.) (Filing Date) (Status)(patented, pending, abandoned)

And I hereby appoint Arthur H. Seidel, Registration No. 15,979; Gregory J. Lavorgna, Registration No. 30,469; Daniel A. Monaco, Registration No. 30,480; Thomas J. Durling, Registration No. 31,349; John J. Marshall, Registration No. 29,671; and Joseph R. Delmaster, Jr., Registration No. 38,123, my attorneys or agents with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

Address all correspondence to Drinker, Biddle & Reath, LLP, One Logan Square, 18<sup>th</sup> and Cherry Streets, Philadelphia, Pennsylvania 19103-6996. Address all telephone calls to Gregory Lavorgna at 215-988-3309 (telefax: 215-988-2757).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Full name of first inventor 1-00 IAN KILNER

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